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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
FIFTH SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2017

Course Code: CH367

Course Name: NUMERICAL METHODS FOR PROCESS ENGINEERS(CH)

Max. Marks: 100 Duration: 3 Hours

PART A

Answer any two full questions, each carries 15 marks. Marks

1 a) Using bisection method, find an interval with permissible error of 1×10^{-2} which contains a root of the equation $f(x) = x \sin x + \cos x = 0$ (7.5)

b) Solve, by Cramer's rule, the system of equation (7.5)

$x + y + z = 1$
$3x + y - 3z = 5$
$x - 2y - 5z = 10$

2 a) Using Newton-Raphson method, find a root of the function $f(x) = x e^{x} - \cos x = 0$. Take $x_0 = 1$. (three iteration) (6)

b) Using Graeffe's root squaring method find the positive roots of the equation (9)
$x^4 + 7x^3 + 7x^2 - 11x - 7 = 0$

3 a) Solve, by Jacobi method, the system of equation (8)

$10x_1 + 2x_2 + x_3 = 9$
$x_1 + 10x_2 - x_3 + -22$
$-2x_1 + 3x_2 + 10x_3 = 22$

b) Describe the relaxation method to solve a system of equations. (7)

PART B

Answer any two full questions, each carries 15 marks.

4 a) Using Lagrange's interpolation, find f(0.15) from the data (7.5)

x	0	0.1	0.2	0.3
f(x)	2.00	2.11	2.28	2.39

b) Find the approximate value of (7.5)

$$I = \int_0^1 \frac{dx}{1+x}$$

Using trapezoidal rule.

5 a) Using Newton forward interpolations estimate f(x) at x = 0.1 from the data (7.5)

x	0	0.2	0.4	0.6
f(x)	2.001	2.151	2.362	2.423

b) Using Gaussian point method, Find the approximate value of (7.5)

$$I = \int_0^1 \frac{dx}{1+x}$$

6 a) Determine the step size that can be used in the tabulation of $f(x) = \sin x$ in the interval $[0, \pi/4]$ at equally spaced nodal points so that the truncation error of the quadratic interpolation is less than 5×10^{-8} (7)

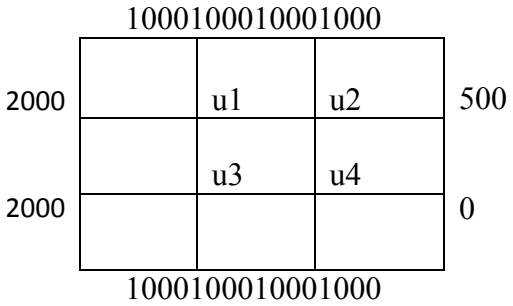
b) Derive Stirling's interpolation formula. (8)

PART C

Answer any two full questions, each carries 20 marks.

7 a) Explain Euler and modified Euler methods used for the solution of ordinary differential equation. (10)

b) Given the values of u(x,y) on the boundary of the square in the figure below, evaluate the function u(x,y) satisfying the Laplace equation $\nabla^2 u = 0$ at the pivotal points of the figure. (10)



8 a) Given the initial value problem (10)

$$u' = -2tu^2, \qquad u(0) = 1$$

estimate $u(4)$ using 2nd order Runge–Kutta method with $h = 0.2$.

b) With h = 0.25, solve boundary value problem (10)

$$u'' = u + 4xe^x, \qquad 0 < x < 1$$

$u(0) - u'(0) = -1, u(1) + u'(1) = -e.$

9 a) Using the Adam-Bashforth third order method solve the initial value problem (10)

$$u' = -2tu^2, \qquad u(0) = 1$$

on [0,1], with $h = 0.2$.

b) Solve $\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2}$ in $0 < x < 5,\ \ t \geq 0$ given that $u(x,0) = 20,\ \ u(0,t) = 0,\ \ u(5,t) = 100$. Compute u for the time step with h=1 by Crank-Nicholson method (10)

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